

**CLAIMS**

0. A connector device for optically coupling an optical fibre to another optical component  
5 to deliver light to or receive light from it, wherein the positional relationship between the end of the said optical fibre and the said other optical component is determined by means for locating the end of the said optical fibre in a predetermined position both parallel to and transverse the length of the fibre with respect to the said optical component.
- 10 1. A connector device according to claim 0 for coupling non-aligned (as herein defined) optical fibres, in which light is directed from the said optical fibre to another by a reflector and the positional relationship between the ends of the optical fibres and the reflector is determined by means for locating the end of each optical fibre to be coupled in a predetermined position both parallel to and transverse the length of the fibre.
- 15 2. A connector device for coupling non-aligned optical fibres as claimed in Claim 1, in which there are provided collimating lenses in predetermined positions with respect to the reflector and to the means for locating the ends of the optical fibres in the said predetermined positions whereby to direct light from one fibre to another via the reflector.
- 20 3. A connector device as claimed in Claim 2, in which the said collimating lenses are integrally formed with the said means for locating the ends of the optical fibres to be coupled, there being provided means for determining the relative position of the reflector and the said means for locating the ends of the optical fibres to be coupled, the latter being adapted to locate  
25 the optical fibre at a determined distance in relation to the focal length of the lenses.
4. A connector device as claimed in Claim 2 or Claim 3, in which the reflector is formed integrally with the said collimating lenses.
- 30 5. A connector device as claimed in Claim 3 or Claim 4, in which the said means for locating the ends of the optical fibres to be coupled comprise a locating member having openings for receiving the ends of the optical fibres to be coupled and means for determining

the relative position and orientation of the said locating member with respect to the reflector.

6. A connector device as claimed in Claim 5, in which the means for determining the relative position and orientation of the locating member with respect to the reflector comprise co-operating form-engagement members on or carried by the said reflector and the said locating member.

7. A connector device as claimed in Claim 5 or Claim 6, in which the said locating member has means for securing it in a predetermined fixed spaced relationship with respect to the reflector.

8. A connector device as claimed in any preceding claim, in which the reflector comprises a generally prismatic element having at least one reflector surface at which reflection takes place by total internal reflection.

9. A connector device as claimed in Claim 8, in which the reflector prism has two reflector surfaces orthogonal to one another.

10. A connector device as claimed in Claim 8 or 9 as dependent on any of Claims 2 to 7, in which the said collimator lenses are formed integrally with the said reflector prism.

11. A connector device as claimed in Claim 5 or any claim dependent thereon, in which the collimator lenses are formed on the locating member or on an intermediate base plate member between the reflector and the said locating member.

12. A connector device as claimed in any of Claims 8 to 11, in which the said reflector surface is metallised to improve reflectivity thereof.

13. A connector device as claimed in Claim 12, in which the said reflector surface is coated with an aluminium, gold or other metal layer acting to improve reflection from the surface.

14. A connector device as claimed in any preceding claim, in which the reflector surface is

formed or associated with a diffraction grating.

15. A connector device as claimed in any of Claims 1 to 7, in which the reflector is a mirror coated on a front or rear surface thereof.

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16. A connector device as claimed in any preceding claim, in which the lenses are cylindrical lenses.

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17. A connector device as claimed in any of Claims 1 to 15, in which the lenses are aspheric lenses.

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18. A connector device as claimed in any preceding claim, in which the collimator lenses are formed by irradiation of selected regions of a body of polymer material, followed by a treatment including selective exposure to a monomer of the same material at or above a critical temperature at which the monomer diffuses into the irradiated regions of the polymer.

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19. A connector device as claimed in any preceding claim, in which the means for locating the ends of the optical fibres to be coupled comprises means for receiving and locating a plurality of input fibres and a plurality of exit fibres.

20. A method of producing a component of a connector device for aligned or non-aligned optical fibres, comprising the steps of:

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irradiating a selected region of a polymer body having a high molecular weight with a particle beam having sufficient energy to be capable of breaking the molecular chains of the polymer,

subjecting the irradiated regions of the polymer material to a subsequent treatment to cause a change in the physical or mechanical properties of the irradiated region to form a component having a desired shape, and/or surface features, and

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reproducing the component using mass production techniques such as micro replication or injection moulding.

21. A method as claimed in Claim 20, in which the component is irradiated with a particle

beam of substantially circular cross section for a time determined in relation to the energy absorbed dose in the region of the particles to produce a substantially cylindrical region of determined length, and selectively removing the modified material by solvent etching to produce cavities of a defined size and shape to receive the ends of optical fibres and locate them in determined positions with respect to the component both parallel to and transverse the length of the optical fibre.

22. A method as claimed in Claim 20, in which the component is irradiated with a particle beam of substantially circular cross section for a time period determined in relation to the energy of the particles, and the subsequent treatment of the irradiated region comprises exposing the surface thereof to a monomer vapour at an elevated temperature at which the monomer diffuses into the irradiated regions to cause local intumescence.

23. A method as claimed in Claim 20, in which the irradiation step is performed with a continuous stream of particles and relative translation of the beam and the polymer body takes place to form an irradiated region of selected shape, and the subsequent treatment results in ablation of the irradiated material to leave a body having a desired shape.

24. A method as claimed in Claim 23, in which the ablation of irradiated material is effected by chemical etching to result in at least one substantially flat smooth surface suitable to act as a reflector.

25. A method as claimed in Claim 22, in which the elevated temperature at which diffusion takes place is in the region of 70°C.

26. A method as claimed in any of Claims 20 to 25, in which the beam of energetic particles is composed of protons or other heavy ions, such as alpha particles, or carbon or lithium ions.

27. A method as claimed in any of Claims 20 to 25, in which the component body is electroplated before being used as a master for reproduction by micro replication techniques.

28. A method as claimed in any of Claims 20 to 27, in which the polymer material is one

having linear molecular chains.

29. A connector device for non-aligned (as herein defined) optical fibres substantially as hereinafter described with reference to, and as shown in, the accompanying drawings.

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30. A connector device for coupling non-contacting optical fibres, comprising at least one lens and means for locating the ends of the optical fibres to be coupled in a predetermined positional relationship with respect to the said lens, whereby to direct light leaving one of the optical fibres substantially entirely into the or an other optical fibre.

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31. A connector device as claimed in Claim 30, in which the said means for locating the ends of the optical fibres in a predetermined positional relationship with respect to the lens comprise at least one alignment plate having openings for receiving the ends of the fibres and locating them in a predetermined position with respect to the said lens.

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32. A connector device as claimed in Claim 31, in which the said lens is integrally formed with a said alignment plate.

33. A connector device as claimed in Claim 32, in which there are two such alignment plates each having one or more lens integrally formed therewith.

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34. A connector device as claimed in any of Claims 31 and 33, in which the opening or openings in the or each alignment plate are tapered.

35. A connector device as claimed in any of Claims 31 to 33, in which the or each opening in the or each alignment plate is a through hole and the position of the end face of the optical fibre is determined by a transparent stop plate against which the end face of the or an optical fibre is contacted upon formation of the connection.

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36. A connector device for coupling optical fibres, in which light is directed from one fibre to another by an optical component or system other than the fibres themselves, in which the positional relationship between the ends of the optical fibres and the said optical component is

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determined by means for locating the end of each optical fibre to be coupled in a predetermined position both parallel to and transverse the length of the fibre.

37. A connector device as claimed in Claim 36, in which the said means for determining the positional relationship between the ends of the optical fibres and the said optical component or systems comprises at least one alignment plate having openings in predetermined positions for receiving the ends of optical fibres.

38. A connector device as claimed in Claim 37 in which the said optical component or system comprises or includes at least one lens formed integrally with the said alignment plate or with another part of the said optical system.

39. A connector device for coupling optical fibres, in which light exiting one fibre is directed to another by optical transmission means outside the fibres in the form of one or more lenses located in a fixed position with respect to fibre end locating means of the connector.

40. A connector device for coupling optical fibres, as claimed in Claim 39, in which the fibre end locating means comprise openings in an alignment plate for receiving the ends of the fibres, the lens or lenses also being formed integrally on the alignment plate.

41. A connector device according to claim 0 for optically coupling an optical fibre to another optical component other than an optical fibre whereby to deliver light to or receive light from it, in which the positional relationship between the end of the optical fibre and the said other optical component is determined by means for locating the end of the said optical fibre in a predetermined position both parallel to and transverse the length of the fibre with respect to the said optical component.

42. A connection device as claimed in Claim 41, in which there is provided a lens in the path of light between the end of the said optical fibre and the other optical component.

43. A connector device as claimed in Claim 42, in which the said lens is one formed by irradiation of selected regions of a body of polymer material followed by a treatment including

selective exposure to a monomer at or above a critical temperature at which the monomer diffuses into the irradiated regions of the polymer.

44. A connector device as claimed in any of Claims 41 to 43, in which the means for  
5 locating the end of the fibre is formed by irradiation of a selected region of a body of polymer material, followed by a treatment including selective exposure to a monomer at or above a critical temperature at which the monomer diffuses into the irradiation regions of the polymer, and thereafter a selective etching of the thus-treated region to result in an accurately formed  
10 opening for receiving the end of the optical fibre whereby to locate it in the said predetermined position.

45. A connector device according to any of claims 41 to 44, in which the said other optical component is a light source.

15 46. A connector device as claimed in any of Claims 41 to 44, in which the said other optical component is a photo detector.

47. A method of producing a connector device as claimed in any of Claims 41 to 46, by the steps of irradiating at least one selected region of a body of polymer material,  
20 treating the irradiated region by selective exposure to a monomer at or above a critical temperature at which the monomer diffuses into the irradiated region of the polymer, selective etching of the thus-treated region of the polymer to result in an accurately-formed opening for receiving the end of the optical fibre to be connected, and optionally treating another part of the body of polymer to form a lens surface.

25 48. A method as claimed in Claim 47, in which a lens surface is formed by intumescence resulting from contact with the irradiated region of the polymer by a monomer vapour.

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